CLAIMS: I claim:

1. A machine used in computing one or more sums of products, comprising:

   a. as a first multiplier input, a first real number which can be a member of a first set of representations in a first finite-precision numeric format for a first set of number values and which can be a member of a second set of representations in a second finite-precision numeric format for a second set of number values

   b. as a second multiplier input, a second real number which can be a member of a third set of representations in a third finite-precision numeric format for a third set of number values and which can be a member of a fourth set of representations in a fourth finite-precision numeric format for a fourth set of number values, where:

      i. said third set of representations in said third finite-precision numeric format has at least one member

      ii. said third set of number values has at least one member

      iii. said fourth set of representations in said fourth finite-precision numeric format has at least one member

      iv. said fourth set of number values has at least one member

      v. said third finite-precision numeric format is not the same as said fourth finite-precision numeric format

   c. combined multiplier means for computing a first product equal to the product of said first multiplier input and said second multiplier input, where:

      i. said combined multiplier means includes first multiplier means for computing said first product when said second real number has a representation from said third set of representations in said third finite-precision numeric format and a corresponding number value from said third set of number values

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ii. said combined multiplier means includes second multiplier means for computing said first product when said second real number has a representation from said fourth set of representations in said fourth finite-precision numeric format and a corresponding number value from said fourth set of number values

iii. said combined multiplier means cannot compute said first product using said first multiplier means when said second real number does not have both a representation from said third set of representations in said third finite-precision numeric format and a corresponding number value from said third set of number values

whereby said combined multiplier means can accommodate a number to be multiplied that may be represented in different finite-precision numeric formats, and whereby said first multiplier means and hence said combined multiplier means can be implemented with lower cost than if said first multiplier means must be able to accommodate all allowed representations and number values of said second multiplier input.

2. The machine of claim 1 in which said combined multiplier means cannot compute said first product using said second multiplier means when said second real number does not have both a representation from said fourth set of representations in said fourth finite-precision numeric format and a corresponding number value from said fourth set of number values, whereby said second multiplier means and hence said combined multiplier means can be implemented with lower cost than if said second multiplier means must be able to accommodate all allowed representations and number values of said second multiplier input.

3. The machine of claim 1 in which said first multiplier input may only be represented in said first finite-precision numeric format, where:

a. said first set of representations in said first finite-precision numeric format has at least one member

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b. said first set of number values has at least one member

c. said second set of representations in said second finite-precision numeric format has no members

d. said second set of number values has no members

whereby said combined multiplier means computes the product of said first real number represented in said first finite-precision numeric format and said second real number, which can be represented in said third finite-precision numeric format or in said fourth finite-precision numeric format.

4. The machine of claim 1 wherein:

a. said first set of representations in said first finite-precision numeric format has at least one member

b. said first set of number values has at least one member

c. said second set of representations in said second finite-precision numeric format has at least one member

d. said second set of number values has at least one member

e. said first finite-precision numeric format is not the same as said second finite-precision numeric format

whereby said combined multiplier means can accommodate multiplication of said first real number which can have representations in two different finite-precision numeric formats by said second real number which can also have representations in two different finite-precision numeric formats.

5. The machine of claim 1 in which:

a. said first set of representations in said first finite-precision numeric format includes all possible representations in said first finite-precision numeric format

b. said first set of number values includes all possible number values supported by said first finite-precision numeric format

whereby said combined multiplier means can accept as said first multiplier input any number represented in said first finite-precision numeric format.

6. The machine of claim **1** in which:

   a. said first set of representations in said first finite-precision numeric format has at least one member but does not include all possible representations in said first finite-precision numeric format

   b. said first set of number values has at least one member but does not include all possible values supported by said first finite-precision numeric format

   whereby said combined multiplier means cannot accept as said first multiplier input all possible number representations in said first finite-precision numeric format.

7. The machine of claim **1** in which:

   a. said third set of representations in said third finite-precision numeric format includes all possible representations in said third finite-precision numeric format

   b. said third set of number values includes all possible values supported by said third finite-precision numeric format

   whereby said combined multiplier means can accept as said second multiplier input any number represented in said third finite-precision numeric format, but where said combined multiplier means may have lower cost when computing said first product when said second real number is represented in said fourth finite-precision numeric format and rather than in said third finite-precision numeric format, with the cost savings resulting from using said second multiplier means rather than said first multiplier means.

8. The machine of claim **1** in which:

   a. said third set of representations in said third finite-precision numeric format does not include all possible representations in said third finite-precision numeric format

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b. said third set of number values does not include all possible values supported by said third finite-precision numeric format

whereby said combined multiplier means cannot accept as said second multiplier input every possible number represented in said third finite-precision numeric format.

9. The machine of claim 1 in which:

a. said first set of representations in said first finite-precision numeric format has at least one member

b. said first set of number values has at least one member

c. said second set of representations in said second finite-precision numeric format has at least one member

d. said second set of number values has at least one member

e. said first set of number values and said second set of number values have no common members

whereby said combined multiplier means cannot accept said first multiplier input in said first finite-precision numeric format when said first multiplier input has a number value in said second set of number values and whereby said combined multiplier means cannot accept said first multiplier input in said second finite-precision numeric format when said first multiplier input has a number value in said first set of number values, so that said combined multiplier means must accommodate representations in at least two different finite-precision numeric formats for two different number values of said first multiplier input.

10. The machine of claim 1 in which said third set of number values and said fourth set of number values have no common members, whereby said combined multiplier means cannot accept said second multiplier input in said third finite-precision numeric format when said second multiplier input has a number value in said fourth set of number values and whereby said combined multiplier means cannot accept said second multiplier input in said fourth

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finite-precision numeric format when said second multiplier input has a number value in said third set of number values, so that said combined multiplier means must accommodate representations in at least two different finite-precision numeric formats for two different number values of said second multiplier input.

11. A method used in computing one or more sums of products, comprising combined multiplication of a first multiplication input by a second multiplication input to produce a first product where:

a. said first multiplication input is a first real number which can be a member of a first set of representations in a first finite-precision numeric format for a first set of number values and which can be a member of a second set of representations in a second finite-precision numeric format for a second set of number values

b. said second multiplication input is a second real number which can be a member of a third set of representations in a third finite-precision numeric format for a third set of number values and which can be a member of a fourth set of representations in a fourth finite-precision numeric format for a fourth set of number values, where:

   i. said third set of representations in said third finite-precision numeric format has at least one member

   ii. said third set of number values has at least one member

   iii. said fourth set of representations in said fourth finite-precision numeric format has at least one member

   iv. said fourth set of number values has at least one member

   v. said third finite-precision numeric format is not the same as said fourth finite-precision numeric format

c. the method of said combined multiplication for computing said first product includes a first multiplication method for computing said first product when said second real number has a representation from said third

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set of representations in said third finite-precision numeric format and a corresponding number value from said third set of number values

d. the method of said combined multiplication for computing said first product includes a second multiplication method for computing said first product when said second real number has a representation from said fourth set of representations in said fourth finite-precision numeric format and a corresponding number value from said fourth set of number values

e. the method of said combined multiplication cannot compute said first product using said first multiplication method when said second real number does not have both a representation from said third set of representations in said third finite-precision numeric format and a corresponding number value from said third set of number values

whereby the method of said combined multiplication can accommodate a number to be multiplied that may be represented in different finite-precision numeric formats, and whereby said first multiplication method and hence the method of said combined multiplication can be implemented with lower cost than if said first multiplication method must be able to accommodate all allowed representations and number values of said second multiplication input.

12. The method of claim 11 in which the method of said combined multiplication cannot compute said first product using said second multiplication method when said second real number does not have both a representation from said fourth set of representations in said fourth finite-precision numeric format and a corresponding number value from said fourth set of number values, whereby said second multiplication method and hence the method of said combined multiplication can be implemented with lower cost than if said second multiplication method must be able to accommodate all allowed representations and number values of said second multiplication input.

13. The method of claim **11** in which said first multiplication input may only be represented in said first finite-precision numeric format, so that:

    a. said first set of representations in said first finite-precision numeric format has at least one member

    b. said first set of number values has at least one member

    c. said second set of representations in said second finite-precision numeric format has no members

    d. said second set of number values has no members

whereby the method of said combined multiplication computes the product of said first real number represented in said first finite-precision numeric format and said second real number, which can be represented in said third finite-precision numeric format or in said fourth finite-precision numeric format.

14. The method of claim **11** wherein:

    a. said first set of representations in said first finite-precision numeric format has at least one member

    b. said first set of number values has at least one member

    c. said second set of representations in said second finite-precision numeric format has at least one member

    d. said second set of number values has at least one member

    e. said first finite-precision numeric format is not the same as said second finite-precision numeric format

whereby the method of said combined multiplication can accommodate multiplication of said first real number which can have representations in two different finite-precision numeric formats by said second real number which can also have representations in two different finite-precision numeric formats.

15. The method of claim **11** in which:

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a. said first set of representations in said first finite-precision numeric format includes all possible representations in said first finite-precision numeric format

b. said first set of number values includes all possible number values supported by said first finite-precision numeric format

whereby the method of said combined multiplication can accept as said first multiplication input any number represented in said first finite-precision numeric format.

16. The method of claim **11** in which:

a. said first set of representations in said first finite-precision numeric format has at least one member but does not include all possible representations in said first finite-precision numeric format

b. said first set of number values has at least one member but does not include all possible values supported by said first finite-precision numeric format

whereby the method of said combined multiplication cannot accept as said first multiplication input all possible number representations in said first finite-precision numeric format.

17. The method of claim **11** in which:

a. said third set of representations in said third finite-precision numeric format includes all possible representations in said third finite-precision numeric format

b. said third set of number values includes all possible values supported by said third finite-precision numeric format

whereby the method of said combined multiplication can accept as said second multiplication input any number represented in said third finite-precision numeric format, but where the method of said combined multiplication may have lower cost when computing said first product when said second real number is represented in said fourth finite-precision numeric

format and rather than in said third finite-precision numeric format, with the cost savings resulting from using said second multiplication method rather than said first multiplication method.

18. The method of claim **11** in which:

a. said third set of representations in said third finite-precision numeric format does not include all possible representations in said third finite-precision numeric format

b. said third set of number values does not include all possible values supported by said third finite-precision numeric format

whereby the method of said combined multiplication cannot accept as said second multiplication input every possible number represented in said third finite-precision numeric format.

19. The method of claim **11** in which:

a. said first set of representations in said first finite-precision numeric format has at least one member

b. said first set of number values has at least one member

c. said second set of representations in said second finite-precision numeric format has at least one member

d. said second set of number values has at least one member

e. said first set of number values and said second set of number values have no common members

whereby the method of said combined multiplication cannot accept said first multiplication input in said first finite-precision numeric format when said first multiplication input has a number value in said second set of number values and whereby the method of said combined multiplication cannot accept said first multiplication input in said second finite-precision numeric format when said first multiplication input has a number value in said first set of number values, so that the method of said combined multiplication must

accommodate representations in at least two different finite-precision numeric formats for two different number values of said first multiplication input.

20. The method of claim 11 in which said third set of number values and said fourth set of number values have no common members, whereby the method of said combined multiplication cannot accept said second multiplication input in said third finite-precision numeric format when said second multiplication input has a number value in said fourth set of number values and whereby the method of said combined multiplication cannot accept said second multiplication input in said fourth finite-precision numeric format when said second multiplication input has a number value in said third set of number values, so that the method of said combined multiplication must accommodate representations in at least two different finite-precision numeric formats for two different number values of said second multiplication input.